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Magnetoelastics of a Spin Liquid: X-ray Single-crystal Diffraction Studies of $Tb_2Ti_2O_7$ in Pulsed Magnetic Fields

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High-resolution single-crystal X-ray diffraction measurements of the frustrated pyrochlore magnet $Tb_2Ti_2O_7$ have been performed using a novel low-temperature pulsed magnet system. This unique instrument allows a thorough characterization of structural degrees of freedom to temperatures as low as 4.4K and in applied magnetic fields as high as 30 Tesla. We show that $Tb_2Ti_2O_7$ manifests several intriguing structural effects under the application of magnetic fields, including strongly anisotropic giant magnetostriction, a restoration of local symmetry in low magnetic fields, and ultimately a structural phase transition in high magnetic fields. A treatment of spin-liquid physics in this compound based on spin degrees of freedom alone seems simplistic, as these results show that magnetoelastic coupling plays a signicant role in $Tb_2Ti_2O_7$ at low temperatures.